

Exploring the Rural Landscape of the Marches of the Welsh Borders in Roman Times Through Intervisibility Analysis

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Article

Exploring the Rural Landscape of the Marches of the Welsh Borders in Roman Times Through Intervisibility Analysis

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Abstract: The distribution of archaeological sites in the rural landscape has attracted the attention of researchers over a long period of time, leading to the several site distribution approaches that have been proposed to explain existing patterns. The main disadvantage of some of these approaches is that they assume a priori a site distribution based on some assumed behaviour such as profit maximisation, among others. The objective of this article is to propose a methodological approach, based on network theory and visibility data, that can generate models that emerge from existing data without imposing a priori assumptions on site distribution. In this approach, archaeological sites are seen as nodes, and visibility between them as links. The approach was applied to a sample of Roman Britain sites located in the Marches of the Welsh Borders. As expected, a model of site distribution emerged from the proposed approach, and the results suggest that people in the Roman period organised the landscape in subareas according to functional as well as symbolic considerations.

Keywords: landscape archaeology; intervisibility; networks; marches; Welsh Borders

1. Introduction

When Romans invaded Britain in 43 D.C. under the power of emperor Claudius, Roman soldiers spread across the country in several regions. When they arrived to the Marches of the Welsh Borders, they established two lines of attack in North and South Shropshire, secured by several camps and fortress along a road joining Chester with Wroxeter. This occupation not only implied a huge cultural impact on the native populations in the region, but also a significant loss of farmlands, forests, and other natural resources for them. By the end of the first century; however, the army was reallocated to Chester, and Wroxeter was left to the local tribal authority with several fortresses occupied by civilian settlements [1].

Archaeological evidence suggests that over the ensuing centuries, societies in the proximity of Wroxeter were influenced by Roman ways to some extent [2,3]. The findings revealed that this city exercised a strong influence on the surrounding area because it directed communal wealth into the town, suggesting the presence of a strong and centralised elite [4]. However, lack of Roman material culture in areas away from urban and road settlements suggests lack of interest in adopting Roman ways in the rural population, or perhaps lack of resources to afford them [5].

Unfortunately, it is difficult to explain this apparent lack of Roman influence and how people organised in the rural landscape of the Marches of the Welsh Borders because rural settlements in this area remained largely unexplored, and only a few studies are available providing cropmark typologies from aerial reconnaissance, revealing a significant number of farmsteads in the area [4].



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Despite this lack of information, it is still possible to obtain some insights into how these settlements were organised by employing intervisibility analysis. The reason is that related research in other contexts has proved that visibility was an important factor in explaining the distribution of settlements. For example, Jones [6] found that Iroquois settlements were connected through visibility, suggesting that visual communication and defence may have been important factors in determining the location of these settlements. Moreover, visibility analysis is considered particularly important because it introduces a sensorial aspect of the landscape. In this respect, Lock [7] explains, “Visibility studies have formed the main response to the critique of GIS outlined above based on the argument that vision is an embodied personal experience and, therefore, situates the analysis within the landscape in contrast to models such as Site Catchment Analysis and Cost Surface Analysis which take a non-situated overview” (p. 180).

The aim of this article is to study the distribution of sites in the Marches of the Welsh Borders by complementing the traditional intervisibility analysis with network analysis. Network theory is part of graph theory, first introduced by Leonhard Euler in the 1700s [8], and considers the existence of nodes that can be connected by links or edges. This information is processed using mathematical algorithms that permit the identification of sets of similar nodes or clusters, as well as particular nodes that have the property of bridging these clusters. In this approach, archaeological sites are defined as nodes, and intervisibility between them as links. The advantage of this approach is that the information about nodes and links can be analysed from formal mathematical network indicators, making it possible to create endogenous visibility network models (EVNMs) of the landscape, that is, settlement distribution models that emerge from the data, avoiding in this way, the introduction of subjective beliefs about settlement distribution (for a discussion on existing approaches to settlement distribution that are based on subjective assumptions, see Evans and Gould [9]; Grant et al. [10]; and Nakoinz [11]). Another key advantage of the proposed approach is that it can be used to explore the nature of sites that have not been excavated yet by studying their relationship in the landscape. This is precisely the case of the current investigation for the sites in the Marches of the Welsh Borders.

It is important to clarify that some researchers have already linked visibility analysis with the network approach to gain a better understanding of how visibility influences the distribution of archaeological sites (for a detailed discussion, see Mills et al. [12]; Rivers, Knappett and Evans [13]; and Cuckovic [14]). Most of these studies have identified the existence of visibility networks of certain monuments. For example, Swanson [15] identified a visibility network of hilltop platforms on Cerro de Moctezuma, Mexico; Bitria [16] identified a visibility network of Iberian hillforts in Catalonia; De Montis and Caschili [17] investigated the hypothesis that the spatial patterns of the Nuraghes towers in Sardinia obeyed rules of intervisibility control over the surrounding territory; Shemming and Briggs [18] identified a visibility network of Anglo-Saxon beacons in the south coast of England; and Galmés-Alba and Calvo-Trias [19] identified a visibility network of Bronze Age and Iron Age monumental communal architecture in Mallorca. These academic works have in common that they explored intervisibility between certain monuments. However, potential visual relationships between these monuments and other contemporary sites have not been explored.

In contrast to previous academic works, the proposed approach considers all types of sites and settlements because it assumes that visibility relationships are not exclusive to single monuments in the landscape. For example, there is no reason to assume that Nuraghes towers investigated by De Montis and Caschili [17] were not visually related to contemporaneous field systems and other sites in the surrounding landscape that may

have influenced their location. This distinction makes the proposed approach a novel contribution to this research area.

2. Methodology

2.1. *The Concept of the Endogenous Visibility Network Model (EVNM)*

Visibility networks have already been introduced in archaeological research. According to Brughmans et al. [20], these networks have been adopted to study past signalling and distance communication, land and sea navigation, and the human experience of architecture, among others. An example is the work by Fábrega-Álvarez and Parceró-Oubiña [21] who analysed how people can be observed and recognised differently at different distances. Extensions in this area of research include, for example, the adoption of exponential random graph models for visibility networks (see Brughmans, Keay, and Earl [22]). This extension aims to explore the dynamic processes that might have led to observed networks. In line with this research, the current investigation proposes a static visibility network. It is recognised in this article that the study of networks through exponential random graph models is a useful approach to exploring the dynamic nature of these networks. However, given the objective of this study, this extension is left for future research. The main characteristics of the proposed static visibility network are described as follows.

The main assumption considered in this approach is that visibility was an important factor in organising the landscape because ancient societies did not have current communication technologies that could assist with this purpose. In fact, visibility is a sensorial factor that is related to all types of sites and settlements within a determined geographical area. For example, a hillfort may be seen from other hillforts as well as from field systems, settlements, pastoral areas, etc. In this sense, the proposed approach is not limited to a subset of contemporary sites, unlike related academic works.

The second main assumption is that an endogenous visibility network model may be formed of clusters of visibility sites (i.e., a subset of sites with a high degree of visibility between them). A cluster may represent areas of the landscape that favour visibility between the sites in the cluster, symbolic arrangements in the landscape, or functional arrangements within the network.

Finally, the third assumption considered by the proposed approach is that clusters may be connected by certain sites that bridge them particularly when they are located far away from one another. This assumption is related to the work by Ogburn [23] who concluded that the human ability to see over long distances can be severely limited by some factors such as atmospheric conditions. If factors of this nature are present in a determined area, then the use of sites to bridge clusters becomes a reasonable strategy.

2.2. *Visibility Analysis*

The most common approaches to visibility are viewshed analysis and cumulative viewshed analysis. Viewshed analysis consists of estimating visible areas from a determined point on a Digital Elevation Model (DEM) assuming a specified height of an observed and target [24].

Cumulative viewshed analysis is an extension of viewshed analysis introduced by Wheatley [25] and consists of adding several viewsheds through a process known as map algebra to generate a visual structure of the landscape by identifying which areas are more visible. This approach has been used to carry out intervisibility studies and to determine whether the ancient sites were sited preferentially with respect to commanding views [24,26].

In the current research, a DEM was created for the area under study using ArcGIS 10.2 software and a Land Form Panorama map obtained from the OS Opendata database¹

(50 m cells and heights given to the nearest 1 m). After that, a binary viewshed for each site was calculated from the DEM using ArcGIS software. In order to account for the height of observers, an OFFSETSA value equal to 1.75 m was considered. Using the Extract Values to Points tool available in ArcGIS, the numeric values (i.e., 1 = visible; 0 = not visible) of the viewsheds generated for each site were extracted. They were used to determine intervisibility links between the sites in the sample.

It is important to describe some potential sources of noise that may affect the results obtained in this study. Firstly, each site in the sample was treated as a single point in the viewshed analysis because the exact dimension of most of them is unknown. Secondly, trees in the past may have prevented visibility between sites. Nonetheless, there is evidence of wood clearance in the area under study [27]. However, this does not mean that trees were totally absent.

For illustrative purposes, Figure 1 shows the viewshed of Llanymynech hillfort (IAROM4) and the visibility network obtained from the network analysis. In this figure, the areas in pink are the ones that cannot be seen from the Hillfort, and the areas in light green are the ones that can be seen from this site.

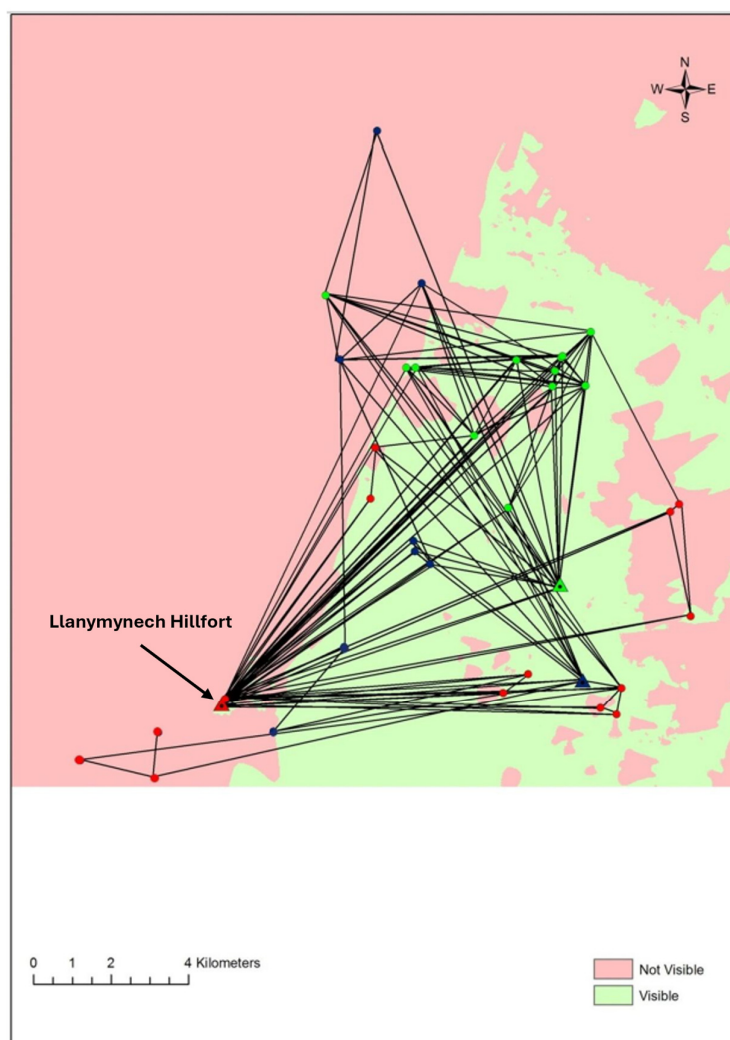


Figure 1. Viewshed of Llanymynech hillfort (IAROM4).

2.3. Generating the Endogenous Visibility Network Model (EVNM)

The information obtained from the visibility analysis was used as input to generate the EVNM. For this purpose, Gephi 0.9.1 software was employed. Information about nodes

and intervisibility links was introduced into this software to process this information using some standard indicators used in network analysis. The ones that are relevant for the current research are degree, modularity class, and betweenness centrality [28]. Degree corresponds to the number of direct links existing in a node and is used to determine sites that are highly connected in the network. Modularity class is a measure that indicates the nodes that belong to the same cluster and was employed to identify potential groups of sites with some common features. Finally, betweenness centrality is a measure that attributes each node a role as a connector and was used to identify sites that bridge the clusters in the network.

How the network was created is explained as follows. Each site was introduced into Gephi using numerical codes (e.g., sites IAROM1 and IAROM2 were named sites 1 and 2, respectively). After that, visibility information between sites was introduced into the software. That is, if two sites can be seen from each other, then it is assumed that the value of the visibility link between these sites is equal to one. In contrast, if two sites cannot be seen from each other, then the visibility link value is assumed to be equal to zero. This information is used by Gephi software to estimate clusters of sites with similar characteristics in terms of visibility through modularity, a measure of the structure of a network that was designed to indicate the extent to which a network could be divided into modules or clusters. This approach involves estimating a modularity value for each node using an algorithm under the assumption that each node belongs to a single class. After that, gains in modularity values are explored assuming that certain nodes belong to the same class. If there is an increase in the value of modularity in these nodes, then it is assumed that they belong to the same class. In contrast, if modularity values decrease, then the opposite conclusion is drawn. This process is repeated iteratively until no gain in modularity values is possible [29]. The information on nodes and visibility links is also used by Gephi software to estimate betweenness centrality, which corresponds to a measure that ranks the nodes according to their participation in the shortest paths of a network [30], and degree, defined as the number of nodes that can be reached from a referential node in one step [31]. The degree, modularity, and betweenness centrality values for each site generated by Gephi's algorithms are shown in Appendix B.

2.4. Area Under Study

The proposed approach was applied to a case study to illustrate the potential of this approach to generate an EVNM. This case study consists of sites located in a determined area in the marches that belong to the Roman period. This area corresponds to 400 square kilometres with its centre being the Old Oswestry Hillfort (Grid Reference SJ 2956 3103) and is located about 25–30 km northwest from the major Wroxeter Roman City. As explained in the Introduction, rural sites far away from Wroxeter have not fully been studied, and what is known from a few studies is that Roman influence is, apparently, not present in these sites. The area under study is presented in Figure 2.

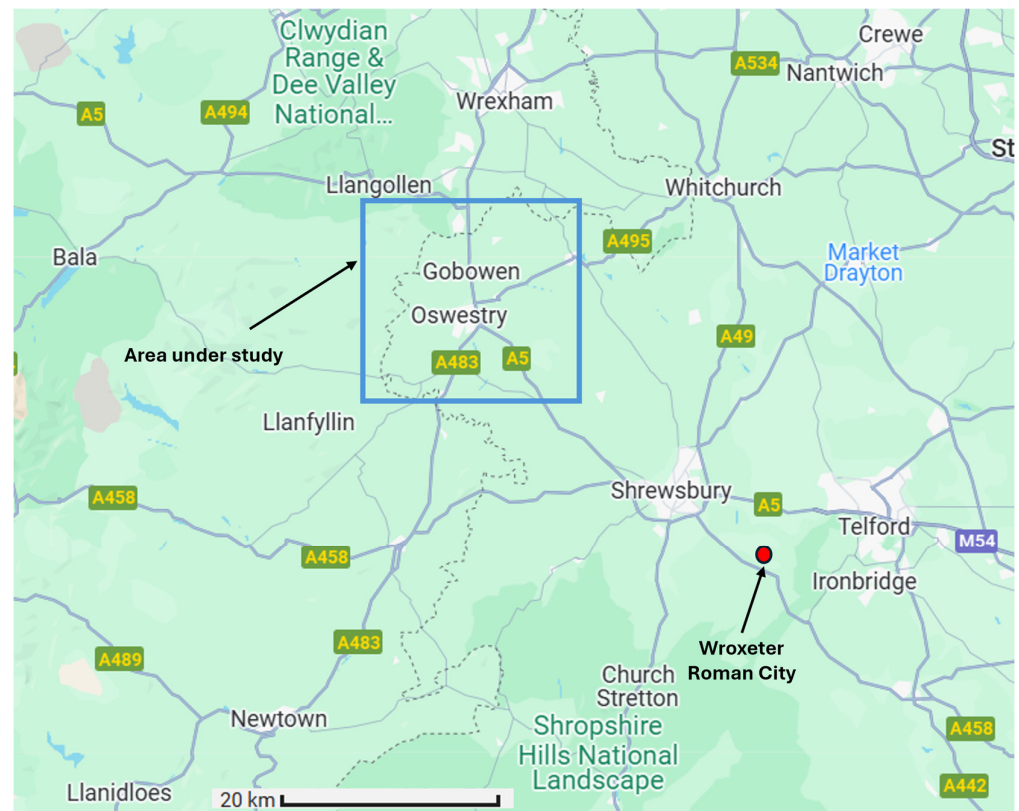


Figure 2. Area under study centred at Oswestry town (400 square meters).

This case study was selected for two reasons. First, there is evidence revealing settlement pattern changes in the Welsh Marshes starting in the Middle Bronze Age as a consequence of climate deterioration, woodland reduction, and grassland replacement [27]. This evidence implies that visibility analysis is more reliable when considering the Roman period than previous ones because of woodland reduction and grassland replacement. Second, the Roman period in Britain lasted for about 360 years. In contrast, previous periods such as the Bronze Age lasted for about 1700 years. This implies that it is easier to consider spurious visibility links between not well-dated Bronze and Iron Ages sites than Roman sites in a network analysis because these links may mistakenly relate sites that were occupied in very distant different periods of time.

2.5. Database

The database used in this research was obtained from Pastcape (available at <https://www.heritagegateway.org.uk/gateway/>, accessed on 20 May 2023) and from the Royal Commission on the Ancient and Historical Monuments of Wales (available at <http://www.coflein.gov.uk/>, accessed on 5 July 2023). The resulting database included 37 sites from Roman times, which are presented in Appendix A.

It is important to highlight the fact that the data used in this study may have some degree of noise. This is because some sites were classified in Pastcape as either Iron Age or Roman. This means that some sites in the sample were occupied during both the Iron Age and the Roman period. It is for this reason that sites that were classified as Roman were named ROM, and sites that were classified as Iron Age sites that were later occupied by Romans were named IAROM. The distribution of these sites in the area under study is shown in Figure 3.



Figure 3. Sites in the sample.

2.6. Field Research

Field research was conducted to explore in the field possible attributes of key sites and clusters identified from the EVNM using the concept of cognitive archaeology. Cognitive archaeology is the study of the minds and cultures of the peoples of the deep past through archaeological remains [32]. That is, it is based on the assumption that the material traces of past activities can be used as clues to the minds that organised those activities [33]. The main idea behind this approach is that humans as a species employ symbols to represent aspects of the real world. However, the meaning that is attributed to a symbol is particular to a particular cultural tradition and the aim of cognitive archaeology is trying to infer the meaning of remains by assembling evidence rather than studying objects in isolation. This approach can also be used to gain an understanding of site distribution and location choice because the planning of sites may reflect a symbolic arrangement involving the perception of significance [34]. In this respect, [35] explain that “a very basic step is the establishment of place by marking and delimiting one’s territory and the territory of the community, often with the use of symbolic markers and monuments, thereby constructing a perceived landscape, generally with a sacred as well as a secular dimension, a land of memories” (p. 391). As an example of cognitive archaeology research, [36] studied the link between visibility, site location, and cognition related to Bronze Age sites in the Central Dalmatian islands in Croatia. A similar approach was adopted in the current research for the EVNM obtained from the proposed approach.

3. Results

A DEM was created using ArcGIS technology, and the sites considered in this investigation were plotted on this DEM map, as shown in Figure 4. According to this figure, there are two distinctive areas, one in the west, formed of hills and characterised by high

altitudes, and another in the east, which corresponds to a valley with low altitudes. Most of the sites in the sample are located in the east area. However, a few of them are located at high altitudes, particularly Iron Age hillforts, which according to the information provided by Pastcape, were later occupied by people in Roman times.

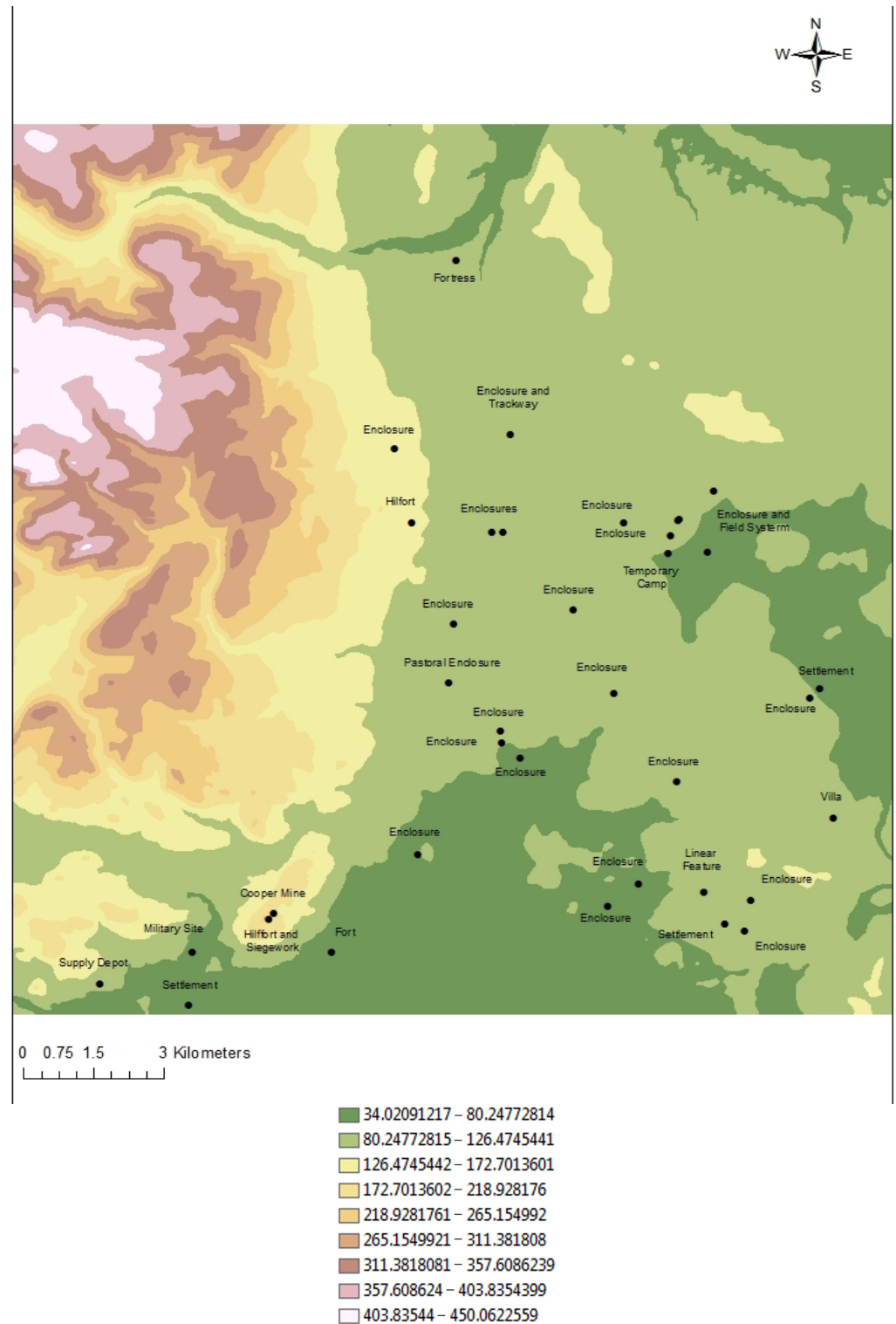


Figure 4. DEM and sites (classes range in metres over the sea level).

The DEM was employed to conduct viewshed analysis for each of the sites in the sample. With this strategy, it was possible to identify intervisibility between the sites in

the sample and to create a visibility network model. The values of the network indicators employed for this purpose are presented in Appendix B. The results are described in more detail in the following subsections.

3.1. The EVNM

This model identified bridge sites and three clusters, referred to in this article as the red, green, and blue clusters. According to the network indicators considered in this model (see Appendix B), most of the bridge sites also present the highest value of degree, implying that they are the most connected sites within their respective clusters. This means that these sites not only bridge their clusters but also occupy a relatively central position within them concerning visibility. The clusters and the bridge sites (represented as triangles) are shown in Figures 5–7.

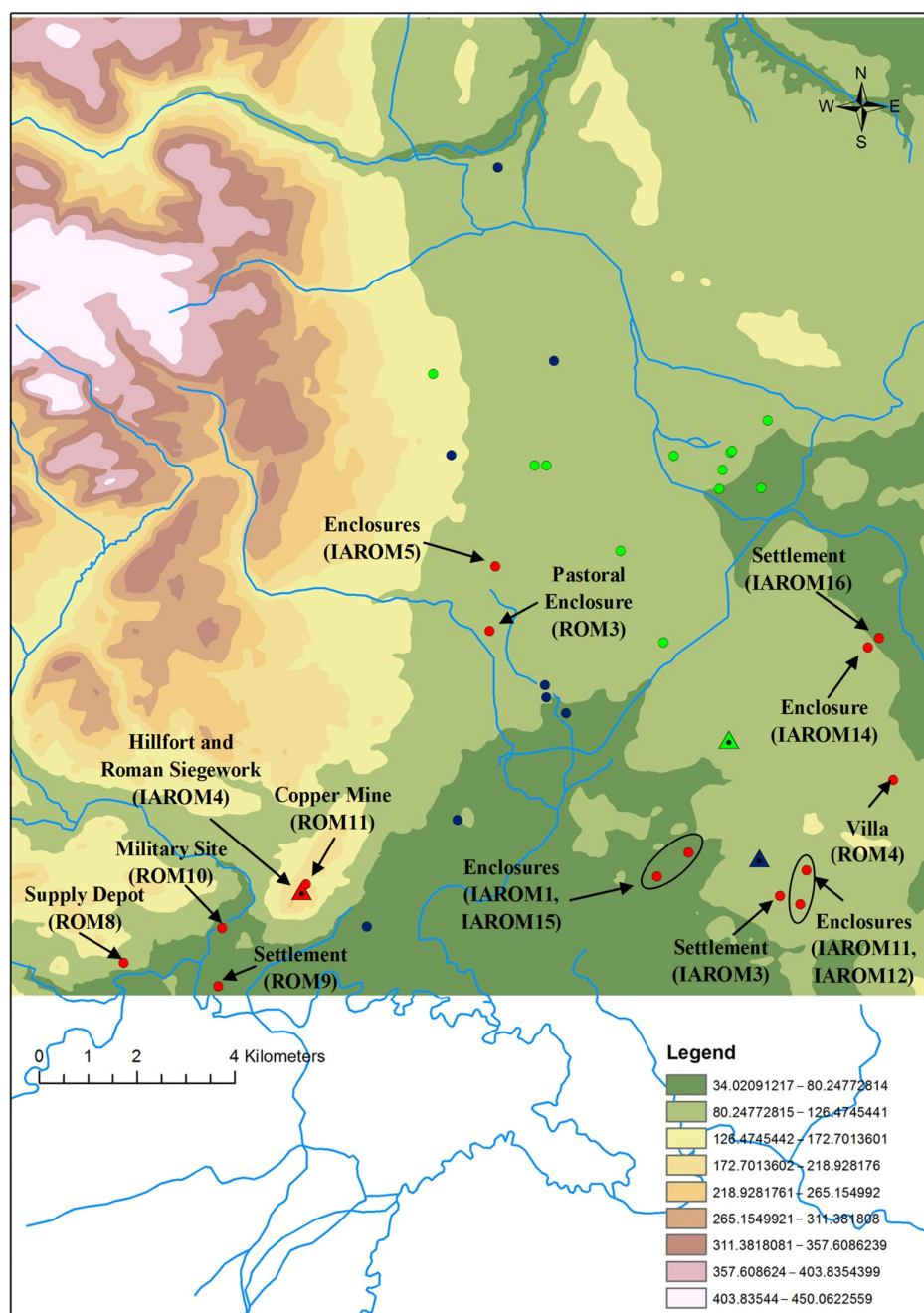


Figure 5. The red cluster.

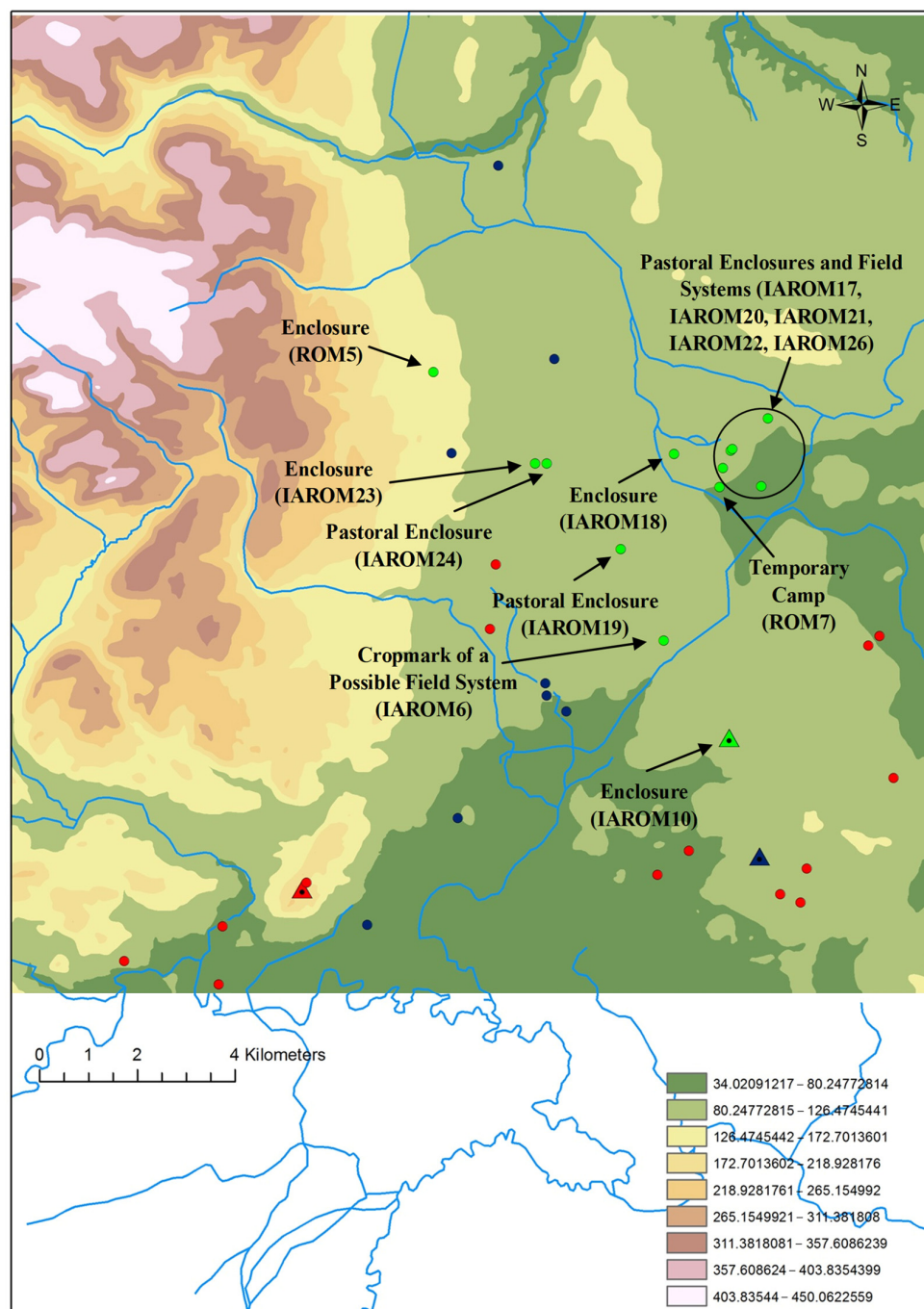


Figure 6. The green cluster.

The red cluster is the dominant cluster of the EVNM and is located in the southern part of the area under study. It is formed of three subareas (Figure 5). The southwest area contains sites consisting of cropmarks of enclosures and a Roman villa. The south-central area contains cropmarks of enclosures and cropmarks of pastoral enclosures. Finally, the southwest area contains the Llanymynech hillfort; a copper mine; a Roman settlement; a Roman military site; and a Roman supply depot. The bridge site of this cluster is the IAROM4 site, which corresponds to the Llanymynech hillfort. Most of the sites that belong to this cluster are aligned along the viewshed of the hillfort, later occupied by Roman siegework. This site is also the site with the higher values of betweenness centrality and degree of the whole network, proving the relevance of this site for the EVNM.

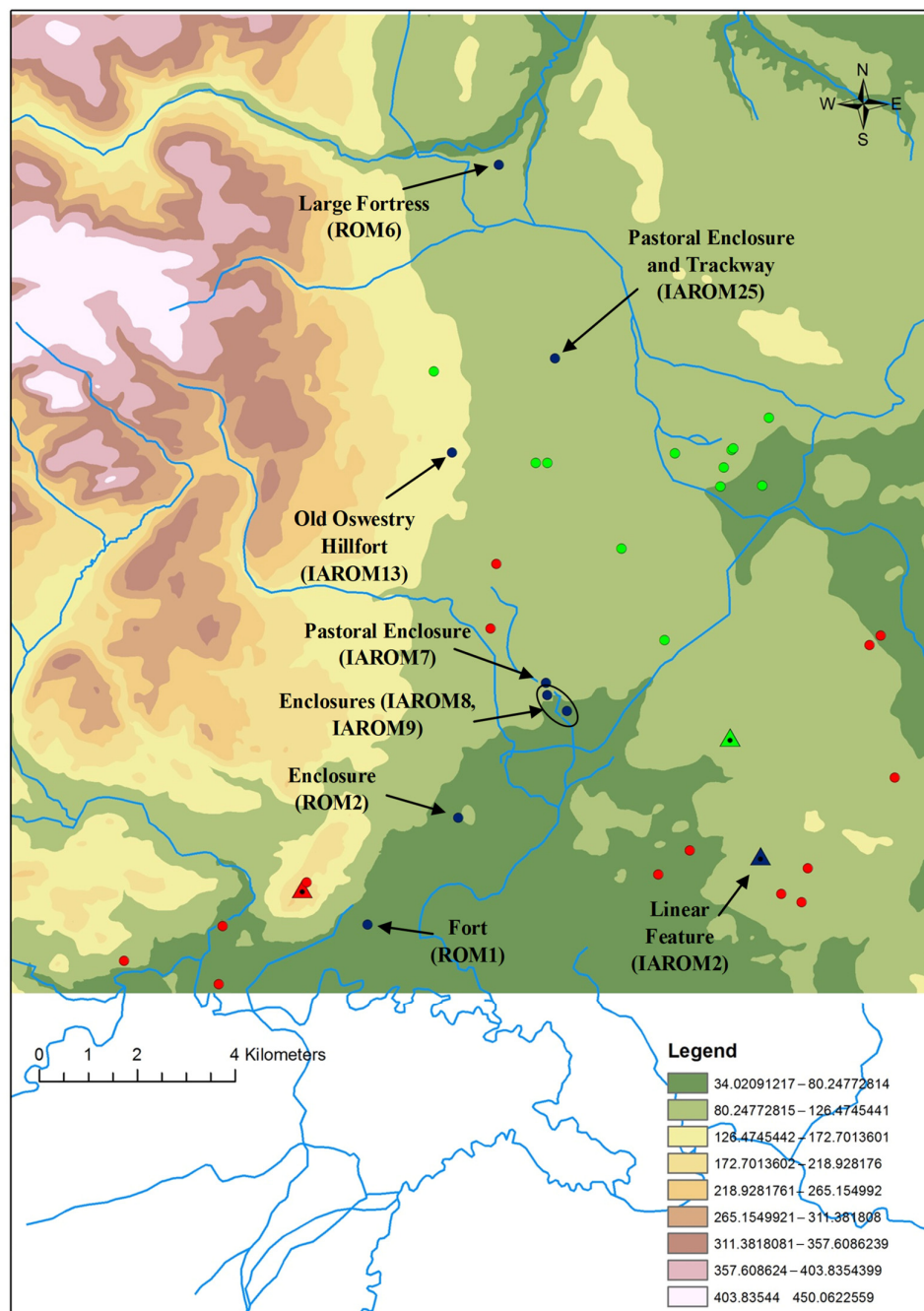


Figure 7. The blue cluster.

The green enclosure is the second dominant cluster in the network and is formed of three subareas (Figure 6). The central–east area contains a concentration of cropmarks of pastoral enclosures and field systems, and a cropmark of a temporary Roman camp. The central–south area contains cropmarks of an enclosure, pastoral enclosure, and a possible field system. Finally, the central–east area contains cropmarks of enclosures and a pastoral enclosure. The bridge site of this cluster is site IAROM10, which corresponds to a cropmark of a single-ditched enclosure.

The blue cluster is located along the hills located in the west part of the area under study (Figure 7). The sites of this cluster are aligned in the north–south direction and consist of a Roman fort, the Old Oswestry Hillfort, a cropmark of a pastoral enclosure, a cropmark of an enclosure, and the Rhyn Park large Roman fortress. The bridge site of this cluster is site IAROM25, which corresponds to a pastoral rectangular enclosure and trackway.

3.2. Results from the Field Research

After identifying some key patterns in the landscape during the field research, the cognitive approach was adopted to infer possible meanings of the clusters and bridge sites. The results are presented as follows.

The Red Cluster: The red cluster is heterogeneous in nature and is composed of four main subareas. The southwest area contains a settlement, a military site, a supply depot, the bridge site (i.e., the Llanymynech hillfort), and a copper mine. The middle centre area contains the cropmark of an enclosure (i.e., IAROM5) and the cropmark of a pastoral enclosure (i.e., ROM3), both located near a river, suggesting that this was an agricultural area located near the boundary of the virtual defensive wall represented by the blue cluster (see a description of this wall below). The southeast area is characterised by undulated lands with medium to sharp slopes. It contains sites IAROM1, IAROM3, IAROM11, IAROM12, IAROM15, and ROM4, which correspond to cropmarks of enclosures, a villa, and a settlement. The main pattern identified in this subarea is that it appears that these sites were located in places with low visibility, although the Llanymynech hill can be seen from some of them (Figures 8 and 9). Because some of these sites correspond to settlements and a villa, it is suggested that this pattern reflects places chosen to establish permanent homes protected from visibility, perhaps to favour privacy and defence.



Figure 8. Site ROM3 (linear cropmarks).

The bridge site of the red cluster is the Lanymynech hillfort (i.e., IAROM4) and corresponds to the site with the higher values of degree and betweenness centrality of the whole network (Figures 10 and 11). Three patterns were identified after the visit to this site. Firstly, the shape and appearance of the site change dramatically when seen from different directions. It looks like a relatively narrow massive hill from the southwest; a massive, monumental structure with impressive cliffs from the south; an elongated hill from the east; and a diffuse structure that confounds with other hills located nearby when seen from the northeast. Secondly, the characteristic features of the hill that can be seen in the proximity vanish as the distance from the hill increases. Finally, visibility from the hillfort (today occupied by a golf course) to the valley located in the east is excellent and

impressive (Figures 11 and 12). However, visibility from the hill to the north is prevented by many hills (Figure 13).



Figure 9. Site IAROMO1 (cropmarks of a sub-circular enclosure).



Figure 10. Llanymynech hill as seen from the south.

In considering the first and second patterns, it was ruled out that this site was linked to power or spiritual meaning because monumental features that may suggest a meaning of this nature can only be seen in the proximity and from the south, but not from other directions or at long distances. It was concluded, consequently, that this site was linked to two other possible meanings. First, it served as a referential point in the landscape as it is easy to determine the current location when seeing the Llanymynech hill from different areas. Second, in considering the impressive view from the hill toward the east valley, it was inferred that this site was also used as a sort of observatory.



Figure 11. Llanymynech hill in proximity.



Figure 12. View toward the west valley.

In summary, the red cluster seems to be a heterogeneous cluster that was subdivided in functional areas, namely protective; observatory; defensive; and homes.

The Green Cluster: Three patterns were identified in the green cluster. First, the lands in the sites that compose this cluster are flat and suitable for agricultural production. Second, the Llanymynech hill can be seen as a diffuse hill from most of the sites that form part of the cluster. Third, a massive wall of hills located in the west part of the area under study can be seen from all the sites in the cluster as well as from non-archaeological sites within the cluster (Figure 14). Finally, this massive wall is the most prominent distant feature that can be identified in the landscape when the area gets dark just before night. This is because the sun disappears behind this wall, making its visual recognition easier (Figure 15). In considering these patterns, it is suggested that the green cluster is an area

specialised in agricultural production. The Llanymynech hill is not a focal point, but it may serve as an indicator of the position of the sites in the cluster. Finally, the massive wall may have had a symbolic meaning of protection that may have been linked to the blue cluster, as described below.



Figure 13. Visibility toward the north prevented by hills.



Figure 14. Massive wall of hills as seen from site IARAMO20 (cropmarks of a pastoral enclosure and field system).



Figure 15. Appearance of the wall of hills when the area is getting dark.

The bridge site of the green cluster (i.e., IAROM10) corresponds to a cropmark of a single-ditched enclosure (Figure 16). This site looks like a common flat field with some undulating areas. When approaching the site from different directions, the only obvious pattern that was discovered is that some non-distant low hills, as well as high massive hills located far away, can be seen in certain directions (Figure 17). In considering the visual pattern and the little (if any) evidence of possible Roman occupation, it is proposed that this site was a secondary place in terms of infrastructure and agricultural production and served mainly as a visual connector for the cluster and perhaps as a meeting point.



Figure 16. Aerial photography of the bridge site of the green cluster (source: English Heritage).



Figure 17. View from the bridge site to a low hill and a high hill.

The Blue Cluster: Three patterns were identified in the blue cluster. First, this cluster is composed of sites that, in general, surround the massive wall of hills located in the west part of the area under study. Secondly, it contains several defensive sites such as forts, military sites, and Iron Age hills that were later occupied by people in Roman times (Figure 18). Finally, most of these sites are located beyond the viewshed of the Llanymynech hillfort (Figure 19). In considering these patterns, it is suggested that the blue cluster is a defensive cluster that forms a defensive virtual wall around the massive wall of hills located in the west part of the area under study.



Figure 18. The Old Oswesrty Hillfort (i.e., IAROM13).



Figure 19. Site ROM1 (alleged Roman fort showing as cropmarks).

The bridge site of the blue cluster identified by the network approach (i.e., IAROM2) is placed on the west-top side of a relatively low and extensive hill located in the southeast area of the red cluster (Figure 20). This bridge site looks like the east counterpart of the Llanymynech hillfort in terms of visibility because it covers a significant part of the viewshed of this hillfort but seen from the east (Figure 21). It also has a clear connection with a massive wall of hills located in the west part of the area under study (indicated in Figure 21). In considering this description, it is proposed that this bridge site played three main roles, namely, as a visual observatory counterpart of the Llanymynech hillfort; connector point of the sites of the red cluster that are also located in the same hill; and connector point of the blue cluster.



Figure 20. View of the hill where the bridge site of the blue cluster is located.

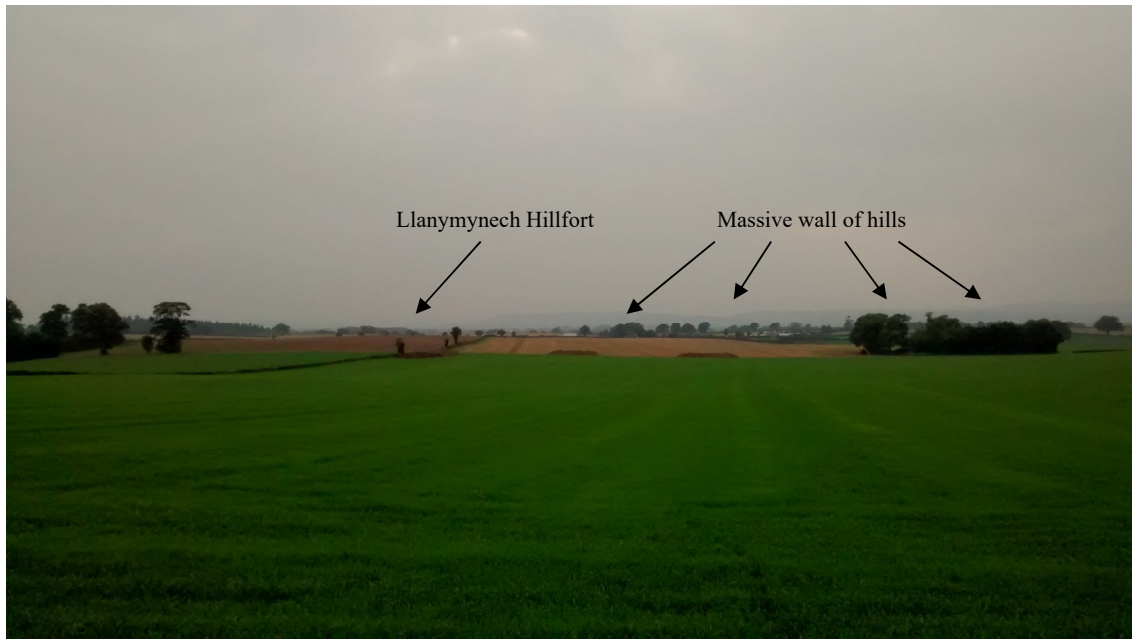


Figure 21. View from the bridge site of the blue cluster to the west.

4. Discussion

According to the results, it appears that the area under study was a planned landscape organised in determined areas linked to functional and symbolic meaning. It was a protected place devoted to agricultural production and metal mining activity.

In particular, it is argued in this article that the red cluster of the network was the dominant cluster, and its complexity was associated with four functional meanings: a place for homes; defence; production; and observation. These functional aspects of the cluster are explained as follows. The southeast area was selected to establish homes arranged in settlements and villages. They were located in areas with low visibility to prevent them from being discovered by potential invaders or for privacy. This area was also strategically selected for its closeness to Wroxeter, a large major Roman city located about 25 km in the southeast direction. Settlements in this area were visually connected to a defensive small area located in the southwest part of the area under study. It was identified as part of the red cluster, suggesting that the main role of this defensive area was to protect the settlements and homes of the people that inhabited the southwest part of this cluster. On the other hand, the red cluster has subareas of agricultural production and copper mining activity, suggesting that one of the main objectives of the cluster was the exploitation of valuable natural resources available in this landscape. The value that people in Roman times attributed to these resources may explain why this place was strongly protected from possible intruders from the west. Finally, the red cluster contains the most important focal point of the whole network: the Llanymynech hillfort. It is argued in this study that this hillfort was used as a referential point in the landscape to determine current locations; as an observatory, given its high number of connections to most of the sites in the network; and as a visual delimiter of the boundaries of the area. In relation to the last function, it is interesting to note that there is a positive relationship between the occurrence of non-military sites and the viewshed of the hillfort and a positive relationship between the occurrence of military sites and areas beyond this viewshed. This finding suggests that settlements and productive areas were indeed valuable for people in this landscape, and this is why they established a visual boundary with defensive points located beyond this boundary.

Regarding the green cluster of the network, it contains sites that are, in general, within the visual boundary, close to rivers, and in relatively flat lands. This cluster is protected by a virtual defensive wall (the blue cluster) suggesting that the area of the green cluster was a major specialised area for agricultural production.

The blue cluster is a defensive one consisting of a virtual visual defensive wall composed of military and defensive sites. These sites are placed along the massive wall of hills located in the west part of the area under study and are also linked to the small defensive subarea located in the southwest part of the area under study. The creation of this defensive wall is the most substantial evidence supporting the argument that the area under study was a strongly protected landscape from intruders coming from the West, probably because of the existence of valuable natural resources. It is also argued in this article that the arrangement of the defensive virtual wall along the massive wall of hills provided the latter an important symbolic meaning for people who inhabited this area. That is, this massive wall was not only a geographical feature but also a structure with a defensive meaning that probably gave people a sense of security. Because the massive wall can be seen from most of the sites in the landscape and is the last feature in the landscape that can be seen during the sunset, this meaning may have been perceived as a metaphorical aspect of the landscape.

5. Conclusions

This article proposes the adoption of visibility and network analyses to explore the distribution of archaeological sites in the landscape. This development offers two contributions to the field of landscape archaeology. First, the approach can create endogenous visibility network models of the landscape, that is, settlement distribution models that emerge from the data and not from subjective beliefs about settlement distribution. Second, it can be used to explore the nature of sites that have not been excavated yet by studying their relationship in the landscape.

The results obtained in this investigation prove that the proposed network approach has the potential to generate endogenous models of site distribution based on visibility information. Moreover, field research analysis can be employed as a complement to gain a better understanding of the features and patterns identified from the network framework. In terms of the results, three clusters were identified in the landscape under study, suggesting that people in this area organised the landscape in terms of functional and symbolic considerations.

In relation to functionality, a cluster in the southern area under study seems to have been a place for homes and the exploitation of natural resources. This cluster might be occupied by higher-status people, given the presence of a villa in this cluster. On the other hand, the cluster in the northern area of this landscape includes several cropmarks in flat lands near watercourses, suggesting a place for pastoral and agricultural production. Finally, a cluster of sites in the western part of the landscape includes defensive sites along a wall of hills in the south–north direction. This cluster seems to be a defensive one and was probably established as a chain of defensive sites to protect the flatter east area from intruders from the west. The clusters are connected through visibility by some sites that apparently serve as bridges between the clusters. The most prominent one is the Llanymynech hillfort, which can be seen from most of the sites included in this investigation.

Regarding the symbolic aspect of the clusters, the observations from the field research suggest that the massive wall of hills in the western part of the landscape may have had a symbolic meaning of protection and orientation because it is the most prominent feature in the area under study. The Llanymynech hillfort, on the other hand, might have been seen as a relevant feature of the landscape, given its high visibility from different parts of this

landscape. Perhaps this hillfort had a symbolic meaning of connection and unity between the people that formed part of this community.

In summary, it was found that people in the area under study managed the landscape in terms of functional (i.e., residential, production, defence, and observation) and symbolic (i.e., defensive virtual wall and virtual boundaries) considerations. It appears that this was a protected satellite area used mainly for mining and agricultural production. Given its proximity to Wroxeter, it is possible that production was traded in this major Roman city.

This article concludes by listing some limitations of the research. First, while the Roman period was relatively brief compared to other periods in the past, it is still possible to have some biased relationships concerning the nature and relationship between sites. Second, only sites that have previously been identified were considered. However, as new sites are discovered in the future, more robust results may be obtained. Third, most of the sites have not been excavated and have been identified as cropmarks, implying a lack of relevant information. This is why the proposed network approach can be considered a complementary tool with which to explore the nature of relatively unknown sites by studying their surrounding landscape. Fourth, the proposed visibility network is static, implying that it is impossible to assess the dynamic nature of this network (i.e., how it was formed). Addressing all these issues is left for future research.

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Appendix A. Database

Site	Monument Number	Grid Reference	Description
IAROM1	66,798	SJ 3375 2238	Cropmarks of a sub-circular enclosure.
IAROM2	1,049,976	SJ 358 227	Cropmark of a sinuous linear feature.
IAROM3	1,049,985	SJ 363 220	Cropmark of a D-shaped enclosure.
IAROM4	66,006	SJ 265 221	Llanymynech hillfort, Roman siegework.
IAROM5	66,636	SJ 3045 2873	Cropmarks of two enclosures.
IAROM6	66,642	SJ 3392 2719	Cropmarks of enclosures—possibly a field system.
IAROM7	66,648	SJ 3141 2633	Cropmarks of a trapezoidal enclosure.
IAROM8	66,657	SJ 3184 2571	Cropmark of an enclosure with a possible hut circle.
IAROM9	66,651	SJ 3146 2608	Cropmarks of single-ditched rectangular enclosures.
IAROM10	66,604	SJ 3523 2519	Cropmarks of a sub-rectangular, single-ditched enclosure.
IAQOM11	1,049,980	SJ 367 218	Cropmarks of a broad-ditched, rectangular enclosure.
IAROM12	1,049,994	SJ 368 225	Cropmark of a D-shaped enclosure.
IAROM13	66,112	SJ 29560 31026	Old Oswestry Hillfort.
IAROM14	66,592	SJ 3807 2710	Cropmarks of a substantial rectangular/square enclosure.
IAROM15	1,049,796	SJ 3440 2292	An oval enclosure with a south-east facing entrance.
IAROM16	1,443,556	SJ 383 273	Earthwork of a small, enclosed settlement.
IAROM17	66,865	SJ 3512 3073	Cropmarks of a rectangular pastoral enclosure.
IAROM18	1,050,213	SJ 341 310	A broad-ditched, sub-rectangular enclosure.
IAROM19	66,622	SJ 3304 2906	Cropmarks of a double-ditched pastoral enclosure.
IAROM20	66,859	SJ 353 311	Cropmarks of a pastoral enclosure and field system.

Site	Monument Number	Grid Reference	Description
IAROM21	66,862	SJ 3528 3106	Cropmarks of enclosures.
IAROM22	66,880	SJ 3589 3035	Cropmarks of a pastoral enclosure and field system.
IAROM23	66,913	SJ 3124 3080	Cropmarks of a sub-rectangular enclosure.
IAROM24	66,916	SJ 3146 3080	Cropmarks of a double- ditched oval pastoral enclosure.
IAROM25	66,931	SJ 3166 3300	Cropmarks of a pastoral enclosure and trackway.
IAROM26	66,868	SJ 3604 3174	A small, enclosed settlement.
ROM1	66,019	SJ 2780 2135	Alleged Roman fort showing as cropmarks.
ROM2	66,054	SJ 2967 2356	Linear cropmarks.
ROM3	66,654	SJ 3034 2742	Cropmark of a rectangular pastoral enclosure.
ROM4	66,682	SJ 3861 2438	Cropmarks of a possible Roman villa.
ROM5	66,134	SJ 2919 3266	Cropmarks of a single- ditched rectangular enclosure.
ROM6	66,831	SJ 305 369	Rhyn Park Roman fortress.
ROM7	66,852	SJ 3505 3033	Cropmark of a Roman temporary camp.
ROM8	275,951	SJ 22831 20635	Cropmark.
ROM9	140,020	SJ 24765 20175	Settlement.
ROM10	306,986	SJ 24876 21348	Cropmark of a fort.
ROM11	307,004	SJ 2656 2221	Copper mine.

Appendix B. Network Indicators of the EVNM

Site	Betweenness Centrality	Degree	Modularity Class
IAROM1	0.0	3	0
IAROM3	0.0	4	0
IAROM4	145.0	27	0
IAROM5	5.6	6	0
IAROM11	0.0	4	0
IAROM12	42.0	9	0
IAROM14	5.7	4	0
IAROM15	0.8	4	0
IAROM16	0.9	3	0
ROM2	2.5	4	0
ROM3	0.2	3	0
ROM4	5.7	4	0
ROM11	143.9	26	0
ROM1	2.4	4	0
IAROM2	88.8	14	1
IAROM7	0.3	6	1
IAROM8	3.8	7	1
IAROM9	0.3	6	1
IAROM13	17.8	10	1
IAROM25	2.9	6	1
ROM6	0.1	3	1
ROM8	2.3	2	1
ROM9	37.5	3	1
ROM10	0.0	1	1
IAROM6	2.9	8	2
IAROM10	38.9	18	2
IAROM17	2.1	11	2

Site	Betweenness Centrality	Degree	Modularity Class
IAROM18	1.9	9	2
IAROM19	6.3	12	2
IAROM20	6.7	14	2
IAROM21	6.7	14	2
IAROM22	7.2	15	2
IAROM23	9.7	12	2
IAROM24	3.6	9	2
IAROM26	25.7	13	2
ROM5	20.6	12	2
ROM7	2.1	12	2

Note

¹ Map available at <https://www.ordnancesurvey.co.uk/opendatadownload/products.html> (accessed on 2 March 2025).

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